

# Topic 2: Organization of the Organism

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## 2.1 Cell Structure

### Animal and Plant Cells

Feature	Animal Cell	Plant Cell
Cell Wall	Absent	Present (made of <b>cellulose</b> )
Chloroplasts	Absent	Present (for <b>photosynthesis</b> )
Shape	Irregular/Round	Fixed/Regular (due to cell wall)
Storage	Glycogen	Starch or Sucrose
Vacuole	Small, temporary, or absent	Large, permanent central vacuole

### Common Cell Structures and Functions

Structure	Location	Function
Nucleus	Present in both	Contains <b>genetic material (DNA)</b> and controls cell activities.
Cytoplasm	Present in both	Jelly-like substance where <b>chemical reactions</b> take place.
Cell Membrane	Present in both	<b>Partially permeable</b> barrier that controls which substances enter and leave the cell.
Mitochondria	Present in both	Site of <b>aerobic respiration</b> ; releases <b>energy (ATP)</b> .
Ribosomes	Present in both	Site of <b>protein synthesis</b> .
Cell Wall	Plant cells only	Provides <b>support</b> and a <b>fixed shape</b> to the cell.
Chloroplasts	Plant cells only	Site of <b>photosynthesis</b> ; contains the pigment <b>chlorophyll</b> .
Vacuole	Plant cells only	Stores <b>cell sap</b> (water, sugars, salts); maintains <b>turgor pressure</b> .

## Specialized Cells

- **Ciliated Cells:** Found in the trachea and bronchi. They have **cilia** (tiny hairs) that sweep mucus and trapped particles out of the lungs.
- **Root Hair Cells:** Found in plant roots. They have a **large surface area** to absorb water and mineral ions from the soil.
- **Xylem Vessels:** Transport **water and mineral ions** from the roots to the leaves. They are dead, hollow tubes with thickened, lignified walls for support.
- **Phloem Vessels:** Transport **sucrose and amino acids** (products of photosynthesis) from the leaves to other parts of the plant.
- **Red Blood Cells:** Transport **oxygen**. They have **no nucleus** to maximize space for haemoglobin and a **biconcave shape** to increase surface area.
- **Sperm and Egg Cells: Gametes** for sexual reproduction. Sperm are small and motile; egg cells are large and contain food reserves.  
(Each of these is covered in more details in further chapters)

## Levels of Organization

Living organisms are organized into a hierarchy of structures:

- 1 **Cell:** The basic structural and functional unit of all living organisms (e.g., muscle cell, root hair cell).
- 2 **Tissue:** A group of **similar cells** working together to perform a specific function (e.g., muscle tissue, xylem tissue).
- 3 **Organ:** A structure made up of **different tissues** working together to perform a specific function (e.g., heart, leaf).
- 4 **Organ System:** A group of **different organs** working together to perform a specific function (e.g., circulatory system, digestive system).
- 5 **Organism:** A complete living thing.

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## 2.2 Size of Specimens and Microscopy

### Calculating Magnification

The relationship between image size, actual size, and magnification is given by the formula:

$$\text{Magnification} = \frac{\text{Image size}}{\text{Actual size}}$$

- **Image Size** and **Actual Size** must be in the **same units** (e.g., both in **µm** or both in **mm** ).

### Converting Units

It is essential to be able to convert between units of length:

Unit	Equivalent in Meters	Conversion
Meter (m)	1	Base unit
Millimeter (mm)	$10^{-3}$	$1\text{m} = 1000\text{ mm}$
Micrometer ( $\mu\text{m}$ )	$10^{-6}$	$1\mu\text{m} = 1000\text{ nm}$
Nanometer (nm)	$10^{-9}$	$1\text{nm} = 1000\text{ }\mu\text{m}$